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SYNCHRONISING FLOWERING TIME IN RICE

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A scheme of hybridization between *indica* and *japonica* types of rice was initiated at the Central Rice Research Institute, Cuttack, India, in August 1950 under the auspices of the International Rice Commission, with a view to combining the desirable qualities of the two. Ten countries are participating and they are, Burma, Ceylon, India, Indochina, Indonesia, Japan, Pakistan, Philippines, Thailand and United Kingdom. Eight varieties of the japonica type from Japan were to be crossed to 33 varieties of the *indica* type received from the other nine participating countries mentioned above. Including special requests from Malaya and Indonesia for additional combinations, a total of 270 cross combinations were programmed to be made. Certain initial difficulties had to be overcome for a successful operation of the scheme, the chief of these being the synchronisation of the flowering times of both *japonica* and *indica* types.

With regard to the flowering time, rices of the *indica* type may be classified into two groups. One group is period-fixed, flowering after the lapse of a certain period of time after sowing, irrespective of the season of the year when it is grown. The other group is season-fixed, flowering only during a particular season of the year, although it may be grown in different times and attain

different stages of vegetative growth. Most of the late maturing rices of the *indica* type flower in late Autumn and ripen in Winter and therefore fall into the latter group.

Under the conditions in Cuttack, rices of the *japonica* type behave as being period-fixed and flower any time of the year 45—65 days after the seed is sown. In contrast to the above, season-fixed *indica* types flower after 90 to 170 days of growth, depending on the time of the year when the seed is sown. This disparity in the flowering times of the two types of rice has to be overcome in order to carry out the work of hybridization.

One way to get around the difficulty is to plant the period-fixed *indica* type periodically at fortnightly intervals, along with the *japonica* type. According to the experience available in Cuttack, the *japonica* type has been observed to flower almost at the same time as the *indica* type sown fortnight earlier.

Another method of synchronizing the flowering time for the period-fixed group of rices is to grow them in pots of different sizes. From the experiment in Cuttack, it was found that the plants grown in pots of 12 inches in diameter with one plant per pot would flower 3—4 weeks earlier than the plants in pots of 6 inches in diameter with three plants in each. However, the plants in the smaller pot, did not grow very well. But plants to be used as the male plant can be grown in the smaller pot because they do produce an adequate amount of pollen, even though the heads may be short.

The above adjustments did not, however, prove satisfactory in the case of late maturing *indica* type which is season-fixed, because the available period for hybridization was limited by the time and duration of flowering of the type. To overcome this difficulty, photoperiod treatment of rice seedlings was resorted to. Short day treatment (8 hours of sunlight exposure daily from 7 a.m. to 3 p.m.) for 20 days was given to rice seedlings 30 days old and it brought most of them to flower within 60 to 80 days after sowing. For certain very late maturing varieties, the photoperiod treatment caused them to flower some 90 days earlier than the normal time. It may be mentioned that some of the period-fixed early maturing rices also responded to the short day treatment.

RICE SEED CERTIFICATION STANDARDS

The following two sections, A and B, are taken from a mimeographed copy of "Rice Improvement and Seed Distribution in the Philippines", by Loren L. Davis, Rice Agronomist, MSA/Manila, February-December, 1952.

A. OUTLINE FOR SEED CERTIFICATION STANDARDS

The following is a proposed outline setting forth the provisions and procedures for the production of certified seed:

1. Classes of Seed

a. Foundation seed shall be seed for high genetic purity produced under the direct supervision of plant breeders of the Bureau of Plant Industry.

b. Registered seed shall be the progeny of foundation seed that is grown and handled by the Bureau of Plant Industry on government-operated seed farms. This seed shall be of high quality and genetic purity and produced under the supervision of technical personnel of the Bureau of Plant Industry.

c. Certified seed shall be the progeny of registered seed that is produced by cooperators with the Seed Certifying Agency in such a manner as to maintain satisfactory genetic purity and quality as prescribed in the regulations of the Seed Certifying Agency.

2. Varieties Eligible for Certification

Only those varieties which possess superior agronomic characteristics and are approved by a committee appointed for the purpose of approving such varieties shall be eligible for certification.

3. Eligibility of Growers

Anyone may grow certified seed who is accepted by the Seed Certifying Agency and who meets all the requirements for production and disposal of certified seed.

4. Eligibility of Land

Seedbeds must be used that have not grown the same crop within a period of six months, and in all cases, regardless of date of previons crop, the field must be free from volunteer plants of the crop being grown for certification.

5. Application for Growing Certified Seed

Application to grow certified seed shall be submitted to the local Agricultural Extension Bureau for recommendations before being forwarded to the seed Certifying Agency for final decision. Aplication forms will be supplied to the Agricultural Extension Bureau by the Seed Certifying Agency.

6. Source of Seed

Growers producing certified seed must plant registered seed. No application for the production of certified seed will be accepted from growers by the Seed Certifying Agency without registered seed allotments sufficient to plant the intended area. The Seed Certifying Agency shall make these allotments.

7. Isolation of Fields

All fields producing seed for certification must be separated from other fields by a distinct boundary such as a fence, ditch, levee, roadway, or barren strip. Crops which readily cross-pollinate such as corn, milo, or beans should be separated by a distance not less than 300 meters.

8. Field Inspection

Crops being grown for certification will be inspected before harvest by a competent inspector authorized by the Seed Certifying Agency. It shall be the responsibility of the grower to notify the Agricultural Extension Bureau 20 days before harvest and request inspection.

The standards for field inspection are defined by crops. In addition, poor

stands, poor growth, lack of uniformity, excessive weeds, or any other conditions which are likely to make field inspection inaccurate or to bring certified seed into disfavour shall be cause for rejecting a crop for certification.

9. Harvesting and Threshing

Harvesting and threshing must be carried out in such a manner as to avoid mixtures and maintain seed identity. Only clean sacks adequately labeled shall be used.

The Seed Certifying Agency representative or other authorized personnel may, at any time, inspect the harvesting and threshing operation to insure the maintenance of purity and identity of the crop.

10. Processing

Recleaning or other processing must be supervised by the Seed Certifying Agency representative or other authorized personnel. The recleaning and processing procedure must insure the purity and identity of the seed to the satisfaction of the inspector. It shall be the responsibility of the grower or owner of the seed to notify the inspector and request inspection at the time of cleaning.

11. Movement of Unprocessed Seed

Seed intended for certification shall not be moved from the farm without notifying the Agricultural Extension Bureau. The Agricultural Extension Bureau must issue permits for all movement of seed from the farm where it is produced if such seed is to remain eligible for certification.

12. Sampling

A sample of the recleaned seed shall be taken by the Agricultural Extension Bureau from each lot of seed intended for certification and forwarded to the Seed Certifying Agency for seed analysis.

Size of sample to be submitted for seed analysis is as follows:

a. One kilo - Cereals, corn, beans, grain sorghums, and other seeds of similar size.

b. 200 grams - Small garden seeds, small legume seeds, and grass seeds.

13. Seed Inspection

The official drawn sample is submitted to the Seed Certifying Agency where it is recorded, and a portion filed for future reference. The remainder is forwarded to the seed laboratory for official test. If the sample meets all the requirement standards, a certificate bearing the laboratory analysis information and notice of final certification will be issued to the grower or owner, and a copy sent to the Agricultural Extension Bureau. If the sample does not meet the requirement standards, a notification of rejection will be sent to the grower or owner of the seed and the Agricultural Extension Bureau, giving the reasons for rejection.

14. Tagging Certified Seed

Seed sold as certified seed must be contained in sacks of good condition and bear the official certification tag of the Seed Certifying Agency. Tags will be sent to the Provincial Officer of the Agricultural Extension Bureau which will supervise the tagging of sacks.

B. SPECIFIC STANDARDS FOR RICE CERTIFICATION

In addition to the general standards for the production of certified seed, the following specific standards are suggested:

1. Field Standards

Mixture of other varieties — maximum one plant per 25 square metres. Red rice—maximum one plant per 100 square metres.

2. Seed Standards

Laboratory purity (minimum)	— 95%
Germination (minimum)	— 80%
Inert matter (maximum)	— 5%
Other varieties	— 5 seeds per 500 grams
Red rice	— 1 seed per 500 grams.

RICE GROWING IN TRINIDAD

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In general, Trinidad conditions are suited to rice growing. Rice is planted in June with the first rains. Rainfall is usually adequate during the growing season but excessive at the harvesting time. In British Guiana there is a pronounced dry season in September-October which permits of more even ripening of the crop and easier harvesting. The yields in Trinidad, however, are much the same as in British Guiana.

The field operations involved in growing the crop may be briefly stated as follows:

Land Preparation. The rice fields in Trinidad are very small, often a few square yards in size, with a few fields of more than half an acre. On such small fields, land preparation must be done by hand forking or bull ploughing and this necessarily delays the preparation of the land until it is sufficiently soft and wet to permit of easy working. But on large fields, like the experimental plots at Freeman Road, St. Augustine, and at Centeno, it is possible to use a tractor-drawn plough or a rotary hoe to prepare the land during the dry season. This has the added advantage of turning under weeds and grass on the land and incorporting them into the soil. The small grower usually cuts and removes them as their presence would clog the bull-drawn plough. Such removal of organic matter can only have an adverse effect on the soil fertility. An experiment has been made to compare the effect of ploughing under the grass and weeds as against removing them, and also of ploughing under a green manure crop, which was cowpea in this case, planted after the rice was cut. These

treatments will be repeated year after year to determine the effect on the rice crop.

Time of Planting. It is essential for high yields to plant rice as early as possible, as the following figures will indicate:

Seed Sown	*Yield*
3/6/47	4,200 lbs. or 26 barrels
4/7/47	3,100 ,, ,, 19 ,,
10/8/47	2,600 ,, ,, 16 ,,
5/9/47	2,200 ,, ,, 14 ,,
6/10/47	1,900 ,, ,, 12 ,,

1 barrel = 160 lbs. of paddy approximately

Seed Selection. In Trinidad, there exist more than a dozen varieties of rice, such as Joya, Kalyaman, Sorro Mootmaria, etc. It is difficult to keep them pure because the average grower doesn't pay attention to the seed used. At present an attempt has been made by the Department to purify them by selection. That is to make single head selections and plant them separately and then select the very best ones from them for multiplication. But for the average grower, he may select a single head of outstanding character in the field and plant the seed the next year in a small box and transplant the seedlings to a small plot. This plot will give one or two pounds of seed, which will be multiplied again the following year so that, in three years, there will be enough seed descended from a single head for planting an acre. It would be a good practice for the grower to make such selection every year but, even it were done every 4 or 5 years, a marked improvement in the yield and purity of the rice could be obtained.

Transplanting, drilling, and broadcasting. Transplanting is a very expensive operation in rice growing and, if large areas are to be developed, alternative methods must be devised. In an experiment last year, seed was broadcast, drilled at 1 ft. x 1 ft. and transplanted. There was no difference in yields between these three treatments, each giving nearly 4,000 lbs. per acre. It must be pointed out that the water was under complete control which accounts for the equal success of the first two methods.

Nursery. Applying fertilizers to the nursery gave bigger seedlings but these yielded no more than seedlings from the nurseries receiving no fertilizers.

Spacing and number of seedlings. These two factors together have a very great effect on the yield per acre and an experiment was carried out to compare yields with planting at 6", 9", 12" and 15" spacing and using 2, 4 and 6 seedlings per hole. There seemed to be little difference in the yield between any of the treatments and the best method is to plant 2 or 3 seedlings about a foot apart. This is the spacing used by the local farmer but he usually puts in far more seedlings, 6 or 8 or even more. These extra ones are wasted. Just as high yields can be got with 2 or 3 and there is a great saving in seedlings from the nursery.

Fertilizer Application. A fertilizer experiment was undertaken in 1948. The result was as follows:

	Yield (Lbs./Acre)	*Increase* (in pound)
Control	2,790	
Amm. Sulphate @ 1 cwt./acre	2,920	130
,, ,, @ 3 ,,	3,420	630
Superphosphate @ 3 ,,	3,080	290
Amm. Sulphate @ 1 ,,		
Superphosphate @ 1 ,,	2,990	200
Muriate of potash @ 1 ,,	2,930	140

None of these treatments seemed to be economic, except perhaps 3 cwt. ammonium sulphate per acre, but fertilizer trials need to be repeated for several years before confidence can be placed in the findings. The indications are, however, that where yields are normally high, say 3,000 lbs. per acre, fertilizers will not give economic responses. If yields are normally less than 2,000 lbs / acre and this is not due to water shortage, a dressing of 1 cwt. per acre of ammonium sulphate applied about a week after transplanting would probably pay.

Second cropping. Where irrigation water is available, it should be possible to grow 2 crops of rice a year on the same land and thus increase production without increasing acreage. In 1947 the first crop was planted as early as the first week in June and harvested in early November, producing 4,000 lbs / acre. About a month before harvesting, the second crop was grown in a new nursery and, immediately after harvesting, the land was ploughed and the seedlings were transplanted. With irrigation water, the crop grew quite well and was cut in February but yields were very poor, only 1,400 lbs./acre or one—third of the first crop.

The explanation of this lies in a phenomenon known as photoperiodism. Certain varieties of plants respond to the length of day and only flower and fruit when the length of day is suitable. This is more marked in many of the temperate crops where the difference in hours of daylight between summer and winter is very marked. Even in Trinidad, however, there is a difference of an hour and a quarter in the length of day between June and December and this small difference is sufficient to affect the flowering of rice. The second rice crop flowers and ripens too soon to give a good yield. Now there are some varieties of rice which are neutral to this effect of photoperiodism. Attempts are in progress to secure some of the seed from India and Ceylon for trying out as a second crop.

Mechanization. Mention has been made of the mechanical preparation of the land. There remains the problem of harvesting. As for the other great cereals, like wheat, oats and barley, rice can be harvested by a grain combine which can be driven into a field and will cut, thresh, clean and winnow and bag the paddy all in one operation. Combines are under

trial in British Guiana but there seems to be little prospect of their being used in Trinidad. Apart from the small fields of individual owners, the weather is too wet at the harvesting time for such a machine to operate satisfactorily. There might be possibilities for a reaper binder which will cut and tie the rice into bundles which can be stacked to dry; after which a threshing machine could be used for beating the rice. The Department has an experimental thresher on order at the moment. It is portable and can go wherever there is a road. It should certainly make the present hand beating far easier and cheaper.

Summary of recommendations

(1) If possible, prepare the land in the dry season by using a tractor-drawn plough or a rotary hoe. It may be necessary to do a certain amount of harrowing with a bull-drawn spiked harrow or with a hoe when the land is flooded before transplanting.

(2) Harrow the nursery as early in the rains as possible, say early in June. Fertilizing the nursery is no advantage provided the land is well prepared and the seedlings grow well.

(3) Transplant to the field a month later, using 2 or 3 seedlings, no more, at a spacing of 1 ft. by 1 ft. approximately.

(4) If the land yields well, say over 2,500 lbs., or 15 barrels per acre, no fertilizer should be necessary. If yields are less than 2,000 lbs., or 12 barrels per acre, and this is not due to a shortage of water, a dressing of 1 cwt./acre of ammonium sulphate should be applied about a week after transplanting, when the land is wet and there is no standing water.

(5) Where irrigation is possible, gradually raise the level of the water to 3 or 4 inches which will serve to control weeds. If the land is well prepared and water can be controlled, no weeding is necessary.

(6) The only attention to be given to the rice until ripening is to control the water at a level of 4 or 5 inches.

(7) About 3 or 4 weeks before harvesting, drain away all the water in order to get the land as dry as possible for cutting.

(8) Before harvesting, go through the field and cut sufficient heads of pure seed for growing in the next season. For every acre of land, collect sufficient heads for 1 lb. seed. This will plant 1/50 acre, or a patch of 10 yards square, and the seed from this will plant a full acre the following year.

"THE JAPANESE METHOD OF RICE CULTIVATION", AS PRACTISED IN INDIA*

1. Make a raised seedbed. Plough paddy land right after the harvest. A seedbed should be four feet wide and three inches high. A space one foot wide should be left between the beds to permit of easy walking without injuring the plants.

For each acre of land in paddy, sow 20 pounds of seed in a seedbed of 1/20th of an acre. This will produce enough seedlings to plant a full acre.

Stir into the soil one basket (30 pounds) of compost of cowdung manure for each eight feet of seedbed. On the same area, also sprinkle $\frac{1}{2}$ pound of a fertilizer mixture, which is made of equal parts of superphosphate and ammonium sulphate.

Smooth the soil and then cover it with fine compost manure about 1/8th of an inch thick. Then cover the bed with a thin layer of ashes.

The seedbed is now ready for the seed.

2. Select good seed. Try to obtain the best possible seed. Put the seed into a bucket of salt water. The poor seed will come to the top and skim them off. Save only the heavy seed in the bottom of the bucket for planting.

3. Plant the seed in the nursery. Sow the seed and cover them with 1/8th of an inch of fine earth. If it doesn't rain in two or three days, water the bed.

4. Care for the seedlings. A week after the seedlings come up, go through the seedbeds and carefully remove all weeds. This is important and must be done. If proper amount of water is given and weeding is done, strong seedlings will be ready early. Transplant the seedlings when the sixth leaf has formed and the plant will be 6 to 8 inches high. Late transplanting lowers the yield. It is better to transplant early than late.

5. Prepare the field. Plough the field right after the harvest. Be sure to fill all cracks in the bunds. Pack these well to stop rats and crabs.

To get more out of the land, one has to put more in. Fifteen to twenty cartloads of compost or cowdung manure is needed for each acre. This manure should be ploughed into the land before puddling,

6. Transplant seedlings. The Japanese treat each seedling as a baby. They pull them out one at a time and are careful not to bruise the stem or break the roots. If the soil is hard, it must be broken with some tool so that the roots can be saved. Never jerk or hammer the plants to remove soil.

When pulling up the seedlings, weeds must be removed. Weeds transplanted in the fields grow faster than rice and lower the yields of grain.

Plant four seedlings to a hill and no more.

The seedlings should be planted

**Condensed from an article on the same subject in The Pioneer, Better Farming Supplement, published in India.*

straight up rather than at an angle. The farmer should hold his fingers along the side of the plants and push them into the soil ahead of the seedlings. In this way, the fingers make way for the tender roots. The more roots that can be saved, the stronger the plants will be.

The plants should be set in squares of 10 inches. This can be easily done by having two workers hold a long string in a straight line. On this string, put markers of 10 inches apart. The seedlings are placed in the soil at the markers. Then the string is moved over 10 inches and the planting at the markers is done again.

7. Fertilizers. Application of fertilizers is most important in the Japanese method of cultivation. A minimum of 100 lbs. of sulphate of ammonia and 100 lbs. of superphosphate should be applied per acre. Even larger quantities are to be used on the advice of local agricultural officers.

8. Care for the crop. No weeds should be allowed to grow in the field. After the crop has grown for two weeks, the farmer should go through the field and remove all foreign growth, get local recommendations as to the use of chemical fertilizers, if available.

From time to time the farmer should move soil scratching tool between the plants. About two weeks before flowering, field cultivation should be stopped, as any more cultivation will lower the yield.

A SUMMARY OF THE RESULTS OBTAINED AND THE WORK IN PROGRESS AT THE CENTRAL RICE RESEARCH INSTITUTE, CUTTACK

The Central Rice Research Institute was established in 1946 by the Government of India for the purpose of undertaking fundamental research on all aspects of rice, with a view to increasing its production in the country. It was also intended that the Institute would help in the co-ordination of rice research in the country and supply technical information on research on rice to scientific workers.

A brief summary of the results obtained so far at the Institute and the work in progress is given below.

General:

One hundred and fifty-five acres were under cultivation during the year. Of these, 53.6 acres were under experiments and 36.5 acres under green manure crop raised for seed purposes, pulses and other miscellaneous crops. The rest of the area, namely 65 acres, was under improved paddy strains, T. 1248, T. 90, T. 141, BAM.9 and T. 1145 for raising pure seed for general distribution. During the second crop season, December-April, 6 acres were put under experiments and 14 acres were under general cultivation for obtaining nucleus seed.

Botany:

There are 2,657 rice varieties in the world collection of genetic stocks at the Institute. Twelve out of 21 wild rices are now available in the collection. The varieties among the genetic stocks are studied for their agronomic, botanical, drought and disease-cum-pest resistant characters, with a view to selecting the most promising ones for direct introduction or for use as parents for hybridization in India. Three hundred samples of seeds were sent to various foreign countries and states. One hundred and five promising varieties were tested in preliminary yield trials during the year and seven of them, which have given significantly higher yields than the control, as from 19 to 63 percent, have been carried forward for further tests in the coming year. So far about 700 varieties have been thus tested in preliminary yield trials and 13 promising selections made are being put under large scale trials.

Selections were made from fields of villagers who grew improved strains from the government. Promising strains giving higher yields than the original stocks have been thus obtained from T. 1222-12, Adt. 4 and Adt. 20.

In the program of hybridization between *japonica* and *indica* rice varieties, a total of 145.407 cross pollinations were done and 4,164 crossed seeds were obtained during the year. Selections were made in the progenies raised from crossed seeds of the previous years. Hybrid strains combining the earliness of 'Aus' and the high yield of late varieties are being evolved. Promising selections have been made in F_3s raised from suitable crosses.

Several hundreds of the genetic stock of rice were grown under various conditions, such as upland and high soil fertility.

Genetical studies on the inheritance of qualitative and quantitative characters were continued during the year.

Agronomy and Chemistry:

One hundred and ten varieties of rice grouped under five different maturity periods were tested in yield trials with local improved varieties as control. Varieties of medium duration have now been obtained which have been giving significantly higher yields than the local standards during the last few years. These will be distributed to the villagers after further tests. A comprehensive coordinated trial with promising Chinese and Indian varieties has been conducted on an all India basis in the mian rice growing regions, with a view to determining the suitability of these varieties under different soil and environmental conditions existing in the country. Data so far received show that 2 of the Chinese varieties and a local selection B.76—1 have done well in most of the places.

In manurial trials it has been found that ammonium phosphate is as efficient as ammonium sulphate. Ammonium chloride, which has been tried for the first time, was also found to give a good response. This year's experiment again confirmed that the sub—surface application of the fertilizer, ammonium sulph-

ate, 2 to 3 inches deep in the soil, was more efficient than the usual method of surface application after planting.

In the study of the response of rice to pre-soaking of seeds in nutrient solutions the results obtained confirm that pre-soaking of seeds in $K_2H\ PO_4$ gives an increase in yield of 5 to 10 percent. Studies on the phosphatic fertilizers on rice production and trace elements were continued.

Mycology:

Out of nearly 460 varieties of rice, which have been under tests during the last five years for their resistance to Helminthosporium disease, six were found to be resistant to the disease not only in these infection tests but also in the general field during the last six seasons. These six varieties are as follows:

Very resistant	— BAM.10
Resistant	— Co.20 & CH.45
Moderately resistant	— T.141, Ch.13 and T.498—2A

Evidences of relationship between the amount of spores of *H. oryzae* trapped in aeroscopes over rice fields and the meteorological factors were obtained during the year. A few grasses have been found to be probably collateral hosts for *H. oryzae*. Work was continued to find the best possible method of estimating losses caused by the 'blast' disease of rice and the data obtained are under review. It was confirmed that the incidence of the neck infection phase of the disease could be brought under control by fungicidal sprayings.

Entomology:

From the experiment on stem borer control, it was found that the borer did not lay eggs for a period of 5 days on the leaves sprayed with or dipped in 0.2 percent BHC, although these treatments had no effect on the egg masses laid on the surface of the leaves. It was further found that there were five broods of the borer in a year and spraying with insecticide to synchronise with the brooding periods would reduce the loss caused by the pest and as much as 32 percent of increase in yield was obtained in one experiment.

The finding about the scent and colour in rice varieties to act as a repellent to gall flies was further confirmed by this year's experiment. The peak period of gall fly incidence was found to be from the middle of October to middle of November and the insect has six broods during the crop season, July to December. During the peak period plants of 60 days old were more susceptible to its attack, as compared with younger or older plants. In preliminary trials, it was observed that spraying the seedbeds with 0.1 percent BHC and dipping the seedlings in a water solution of the same insecticide before transplanting to be followed by three sprayings on the transplanted crop, significantly reduced the gall fly incidence.

Sweet flag or *acorus calamus*, an indigenous insecticide was found to be more effective in controlling pests in stored grains than either BHC or DDT. 1 lb. of sweet flag mixed with 100 lbs. of paddy was found to be an effective dose to control any storage pests.

Farm:

In addition to the testing out under field conditions of the results obtained by the different research divisions, the Farm Division also gave advice to 8 villages around the Institute during the year. 619 mds. of paddy and 50 mds. of *daincha* seed for green manuring were distributed. The method of transplanting and its advantages were demonstrated in each of the villages. *Tacavi* loans to the tune of Rs. 52,195 were made to the cultivators for purchasing ammonium sulphate, compost and seed. Seed for growing a second crop of rice was distributed to the cultivators and the seedlings were also raised on the farm for issuing to them on request.

FERTILIZATION AND RICE PRODUCTION

K. Ramiah

Every country in Asia irrespective of whether it is a surplus or a deficit one with regard to rice is attempting to increase its home production of this commodity. In attaining the above objective greater emphasis is laid generally on increasing the acre yields of existing rice areas. The programs either in progress or under consideration relate to such aspects like improvement of existing water supplies, breeding new varieties of rice, fertilizing the fields suitably, better control of losses due to diseases and pests, etc. While it takes time for the programs to produce substantial results, there is no doubt that proper fertilization of the rice fields must be considered the most important and capable of producing immediate results.

The preeminence of Japan among Asiatic countries in producing the highest acre yield is in a large measure the result of judicious and intensive fertilization of the fields practised there. Soils in Japan are inherently poor in the chief plant foods and have been continuously cropped for hundreds of years and a high production level can be maintained only by the use of large quantities of both bulky organic manures and chemical fertilizers. Japan is the most intensive user of plant food in the world. Besides organic manures she uses as much as 4,000,000 tons of chemical fertilizers. During World War II, chemical fertilizers were in short supply and in spite of the fact that more composts were used at the time, production did suffer. Since the war the production of fertilizers has been restored, and at the present moment she is even exporting some fertilizer, chiefly sulphate of ammonia.

Early in this century when Formosa and Korea came under the control of Japan, increasing the then existing level of rice production received their first attention and acre yields were soon pushed

up chiefly by the use of fertilizers. Production of new verieties and improvements in cultivation practices also received due consideration. Next to Japan, Korea and Formosa are the two countries that record acre yields very much higher than in other Asiatic countries, and it is also here that much greater use is made of fertilizers for rice growing. In fact, the level of rice production was so much dependent on the use of fertilizers, particularly sulphate of ammonia, in these countries that its nonavailability during the war brought down production appreciably. Fertilizer supplies in Formosa have been restored since the war, mainly by imports and more recently fertilizer plants are being established in the country through the help of JCRR. The position in S. Korea is still precarious. All its fertilizer requirements have to be met by imports. While the rice area is mostly concentrated in S. Korea, the industrial resources in the way of raw materials and power are obtainable only in N. Korea. In fact, before World War II undivided Korea with its own plants in the north had sufficient supplies of fertilizers. Since the communist war in 1950, UNKRA is helping S. Korea by importing the necessary amount of fertilizers and is also considering plans for more permanent arrangements if possible, within the country.

That the use of fertilizers has an intimate relationship with the variety of rice grown is also evident from the experience available in Formosa. While Japan and Korea grow exclusively *japonica* rice, Formosa grows both *japonica* and *indica* though there was no *japonica* there before the Japanese occupation. The Japanese technicians introduced *japonica* and started acclimatizing them and also using them as parents for crossing with the local varieties which perhaps had originally come from Chinese mainland. Within a period of 20 years suitable *japonica* types with high response to fertilizers had been developed and were being grown extensively in the northern and central portions of the island. The *japonica* types grown in Formosa go by the name of *horai* rice and Taichu 65 is a noted example of *horai* rice developed in Formosa. Special mention has to be made in this connection of the work of Dr. K. Iso who has been associated with rice improvement programs in Formosa for over 40 years. The extension of area under *horai* rice, increased use of fertilizers and greater rice production in the island all went together. During the war when fertilizer supply became short, area under *horai* rice went down with a switch over to *indica* types as farmers did not find it profitable to grow *horai* rice without fertilizers. With the restoration of fertilizer supply since the war, area under *horai* rice has gone up again and the total production of the island is also going up. Other aspects of improvement like better water supplies and seed projects also are receiving attention.

In contrast to the situation described in the above paragraphs the problem of fertilizing rice fields is not receiving the attention it deserves in the other rice

producing countries of Asia. The quantity of fertilizers used for rice in countries, Burma, Thailand, Indochina, Indonesia, Pakistan and the Philippines is almost negligible. The position in India may be slightly different in that she has been using during the last few years over 300,000 tons of sulphate of ammonia every year. When it is remembered that India has nearly 70 million acres under rice and only about 60 percent of the above sulphate of ammonia has been used for rice, it cannot be said that the use of fertilizer for rice is a common practice. While previously the bulk of sulphate of ammonia used in the country was imported, in the last year or two local productian has gone up to the tune of 400,000 tons and there are proposals under consideration for further augmenting indigenous production. In several parts of the country, particularly in the South, rice farmers are becoming fertilizer minded and there is no doubt that the use of fertilizers for rice will go up unless the present level of prices for rice appreciably goes down.

Very recently all rice growing states in India have undertaken a large scale campaign of increasing rice production by adopting what has been termed Japanese method of rice cultivation. Several cultural improvements in the growing of rice are being adopted but the most significant of them is the larger use of manures and fertilizers. The Central and State governments are providing all the necessary inducements to farmers by selling the fertilizer at a slightly reduced price and on credit basis. Moreover the U.S. technical aid program will also be undertaking this year a large scale demonstration of the use of fertilizer for rice and other cereal crops. It must, however, be said that there is enough experimental data available from both the research stations and cultivator's fields to undertake a large scale program of manuring rice fields. Even in the campaign of the Japanese method the quantity of fertilizer application recommended for different areas is based on such experimental results.

With regard to other countries the available experimental data on the use of fertilizer for rice is rather limited and the first step should therefore be to obtain the data before any campaign on the use of fertilizer can be undertaken. Malaya is however an exception as comprehensive experiments on a wide scale on the use of fertilizers for rice have been in progress during the last 2-3 years and enough data have been collected. In many of the countries data that would be necessary will be of two kinds, one from properly replicated experiments with a large number of treatments carried out at a few centres representing soil or agricultural zones, and the other from a large number of simple trials or demonstration plots in every zone with a limited number of treatments. While theoretically the undertaking of the latter may have to wait for the former to be completed, in practice mainly to save time, it may be useful to take up both the trials simultaneously utilizing whatever limited data was available in experimental stations. The problem is fortunately

receiving the attention of the MSA or TCA teams working in some of these countries particularly Thailand and the Philippines and to a small extent in Burma also. The results already obtained in these countries are sufficiently encouraging and there is no doubt that a suitable program will soon be undertaken.

One thing that has to be remembered in the use of fertilizer for rice is that any campaign that may be undertaken now does not solve the problem completely. With the data available the campaign undertaken may be for the use of nitrogen only in one case, phosphorus only in another and a combination of the two with potash also in a third. Problems are likely to arise as to the forms of nitrogen and phosphorus to be used and the correct quantities of each. While ammonium sulphate is the chief form of nitrogen in use now it is possible that under certain conditions a different form of nitrogen would prove more valuable. As the fertilizer industry is rapidly developing, there may become available other concentrated forms of fertilizers which would prove more economical to use. Moreover, the price of grain or price of fertilizer or both may change and information would be needed on the optimum quantity to be used for a given price ratio of grain and fertilizer. Furthermore, information should be desirable on the effect on soils of the continued use of a particular fertilizer. When it is remembered that the presence of sufficient organic matter in the soils is important under tropical conditions information would be necessary on how far nitrogen requirements can be met by a combination of organics and inorganics. Finally, as the practice of using fertilizer increases, there should arise a necessity to breed special varieties to get the maximum benefit out of the application of fertilizers. It is therefore evident that more and continued research will be needed not only on the use of fertilizers and their effect on soils but also on evolving new varieties which would give the maximum response for a particular level of fertilizer application.

A PUBLICATION ENTITLED "EQUIPMENT FOR THE PROCESSING OF RICE" HAS BEEN ISSUED AS FAO DEVELOPMENT PAPER No. 27

It contains 55 pages, including 49 illustrations showing types of equipment of both primitive and modern design and of various sizes which may be used in the processing of rice, and indicates where each of these machines or pieces of equipment may be used in rice processing procedures. Copies have been distributed to Member Governments of FAO and further copies may be obtained either from FAO headquarters in Rome or from any one of the various sales agents for FAO publication. The price is U.S. $ 0.50 or 2/6d, or the equivalent if purchased from sales agents in other currencies.

PROVISIONAL AGENDA FOR THE TWO WORKING PARTIES

The two Working Parties of the International Rice Commission will meet in Bangkok by kind invitation of the Government of Thailand simultaneously from 21 to 27 September 1953 inclusive.

The Provisional Agenda for the two Working Parties are as follows:

Provisional Agenda for the Fourth Meeting of the Working Party on Rice Breeding

1. Opening Ceremonies (jointly with Working Party on Fertilizers)
2. Election of Chairman
3. Adoption of Agenda
4. Election of Drafting Committee
5. Country Reports on Progress in Rice Breeding in 1952
6. The International Rice Hybridization Project:
   (a) Progress Report
   (b) Country Reports on experience with material grown in 1952
7. Cooperative Research Projects—Progress Reports:
   (a) Resistance to Lodging
   (b) Interaction between Varieties and Fertilizers
   (c) Interaction between Varieties and Transplanting
   (d) Photoperiod Response
8. The International Training Centre on Rice Breeding
9. The Maintenance of Genetic Stocks of Rice
10. The World List of Plant Breeders
11. Seed Multiplication and Distribution Programs in Member Countries
12. Breeding for Resistance to *Piricularia* and *Helminthosporium*
13. Physiological Diseases of Rice (jointly with Working Party on Fertilizers)
14. Experimental Designs for Varietal Testing and Fertility Surveys (jointly with Working Party on Fertilizers)
15. Plant — Soil — Water Relationships (jointly with Working Party on Fertilizers)
16. Other Business
17. Consideration of Draft Report.

Provisional Agenda for the Third Meeting of the Working Party on Fertilizers

1. Opening ceremonies (jointly with Working party on Rice Breeding).
2. Election of Chairman
3. Adoption of Agenda.
4. Election of Drafting Committee.
5. Report on International Training Centre on Soil Fertility, Coimbatore, India. July 15 - October 15, 1952.
6. Coordinated Research Projects and other Experimental Data.
   (a) The analysis of unoxidized paddy soils.
   (b) Nitrogenous fertilizers.
   (c) Phosphatic fertilizers.
   (d) Varietal interactions with nitrogenous and phosphatic fertilizers.

(e) Micro-nutrients.

(f) Organic and green manures.

(g) Lime.

(h) Placement techniques.

(i) Other aspects.

7. Productivity of Paddy Soils in Rice Producing Countries.

8. Physiological Diseases of Rice (jointly with Working Party on Rice Breeding).

9. Experimental Designs for Varietal Testing and Fertility Surveys (jointly with Working Party on Rice Breeding).

10. Plant — Soil — Water Relationships (jointly with Working Party on Rice Breeding).

11. Other business.

12. Resolutions and Recommendations.

13. Submission of draft report of the meeting for approval.

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